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Quantum Theory, Standard Model, Yang-Mills (Mass Gap), and the New Model

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Abstract

With the discovery of the atom by Einstein (1905) and the proof that atoms have subdivisions, Rutherford (1911), that they are composed of other smaller particles, the formation of the theory of Quantum, the theory of the particles that are inside the atom, began. It was first discovered that each atom consists of a nucleus which is also the solid part of the atom, which consists of protons (particles with a positive electromagnetic charge) and electrons (particles with a negative electromagnetic charge) around which other electrons revolve. Then it was discovered that the assumption that atoms consist of a nucleus of protons and electrons, around which other electrons revolve, was not correct, but it was discovered that the nucleus consists of protons and uncharged particles, (not electrons), which the theory of Quantum, called them neutrons, James Chadwick (1932). With the progress of the research, it was discovered that protons and neutrons, which make up the nucleus, also have subdivisions, the particles, up and down quarks, Murray Gell-Man (1970).

With the discovery of the up and down quarks which together with the electron were considered to be the elementary particles i.e. the smallest subdivisions of matter, the foundation of the theory of the Standard Model, (the theory for the research of the elementary particles and antiparticles) began, as an offshoot of the Quantum theory. The Standard Model theory was completed with the discovery of the Higgs boson (2012), a particle that is not an elementary particle but has the property of contributing to creating the mass of other elementary particles and antiparticles.

The calculations and the various elements of the subatomic and elementary particles of the theory of Quantum and Standard Model are based on the Yang-Mills equations formulated in the 1970s and are based on the acceptance that the subatomic and elementary particles of the microcosm have the same laws that also have the macrocosm. The successful use of the Yang-Mills theory to describe the interactions of elementary particles depends on a subtle quantum mechanical property called "mass gap"[1]. Experiments and computer simulations suggest the existence of this "mass gap" in the solution of the Yang-Mills equations, but no theoretical proof of this property is known. The property has only been discovered by physicists in experiments and confirmed in computer simulations, but has not yet been understood theoretically. Theoretical physicists believe that the explaining of the "mass gap" property will require the introduction of new fundamental ideas in both physics and mathematics. To stimulate the interest of scientists in the solution of the Yang-Mills "mass gap" problem, it was included as one of the seven unsolved problems of the Millennium Prize designated by the Clay Mathematics Institute, which has offered a prize of one million dollars for its solution.

With the progress of the research, it was found that while the theory of Quantum is based on very strong and correct scientific foundations, the theory of the Standard Model, apart from having to clarify the case of the "mass gap" before its establishment, it has to clarify a lot more weak points such as, whether the electron and the up and down quarks are indeed elementary particles, whether or not quarks move inside the nucleus of the atom, whether bosons exist, what about elementary interactions, whether the Higgs mechanism, for the origin of the mass of elementary particles is a

[1]As will see, in section 3 the "mass gap" is the difference between the mass of the absolute vacuum, assumed to be zero and the mass of the lightest elementary particle predicted by the Standard Model theory.

correct mechanism etc. [5], [6] and [7]. However, regardless of the clarification of the above points of the theory of the Standard Model, in section 5 I propose a New Model of description of the elementary particles to supplement or to replace the Standard Model. The New Model also answers all the unanswered questions of the Standard Model, includes gravity, and clarifies what exactly is happening with the Yang-Mills "mass gap".

1. Introduction (The Discovery of the Atom)

With the word "matter" we define the substance with which the various material bodies are structured. Matter is perceived by humans, from a series of its properties, such as its weight, mass, volume, form, etc. Among the first to be concerned with the constitution of matter, were the Ancient Greek philosophers, among whom stand out the names of the Pythagoreans, Thales of Milesius, Anaximander, Heraclitus, Zeno of Eleat, Diogenes, and many others who each in their way interpreted the behavior and entity of material bodies.

Notable were the views of Aristotle (350 BC) who believed that matter in the Universe consists of four elements, earth, air, water, and fire. Two forces acted on these elements. These forces were gravity, manifested by the downward tendency of earth and water, and lightness, manifested by the upward tendency of air and fire. It is remarkable that this standard, of the separation of the components of the creation, evolution, and functioning of the Universe, into matter and forces, is still used to this day.

According to Aristotle, matter is continuous. That is, we could divide a piece of matter into small pieces, without any limit. In this sense there is a continuous division of matter, meaning that we will never meet a piece of matter that we cannot divide into smaller pieces. On the other hand, Democritus argued the opposite. That is to say that matter by its nature is granular and that every material body consists of a very large number of different atoms. In this case, with the word "atom" Democritus characterized exactly the last subdivision of matter, after this subdivision, matter could no longer be divided further.

The research and discussions on the different views of Aristotle and Democritus lasted for many centuries, without either side being able to present any theoretical or experimental proof, that would confirm the correctness of their views. This lasted until 1803, when the famous British physicist Dalton, trying to explain the phenomenon of the constant ratio of elements in various chemical reactions, formulated the idea that this phenomenon is because matter consists of small particles which he called "atoms", using the same name that Democritus had used twenty centuries ago.

The above dispute between the views of Aristotle and Democritus, as supplemented by Dalton, continued for another century until 1905, when Einstein made a very important observation about the existence of atoms: Einstein's observation was that, within a liquid, or a gas, there is a random continuous movement of various microparticles of dust. This movement, (to which physics has given the name of the scientist who observed it, calling it "Brownian motion"), as a natural phenomenon, could be explained, only by the movement of "atoms", in the liquid or into the gas and their collision with the dust particles. Thus, with Dalton's observations, on the phenomenon of the constant ratio of elements in the various chemical reactions, and then by Einstein on "Brownian motion", the experimental proof was given that matter is made up of various small particles, the "atoms", which were initially considered to be elementary particles, i.e. the last subdivisions of matter.

2. The Subatomic and the Elementary Particles. The Quantum Theory and the Standard Model Theory

At that time, around 1910, after the experimental proof of the existence of the atoms, there were already suspicions that atoms, in turn, must not be elementary particles, but must also be composed of other smaller elements of matter. Certain particles known today as "electrons", with a negative electrical charge, whose mass was much lower (about one to two thousand times) than the mass of the Hydrogen atom, had already been identified experimentally. The detection of electrons led scientists to the indisputable conclusion that there were other smaller subdivisions of matter after atoms. Therefore, its division did not stop at atoms but continued even more.

In 1911 the British physicist Rutherford proved that atoms are subdivided into smaller particles, specifically that they consist of a nucleus which is positively charged around which revolve electrons, negatively charged particles which had already been discovered. The nuclei of atoms were then considered to be composed of electrons and protons, where protons were particles like electrons but with a positive electrical charge, and they got this name because they were considered to be, together with electrons, the elementary particles and the fundamental units of matter. This is how the Quantum theory of subatomic particles began to be established, with the atom taking the form of the Figure 1 below.

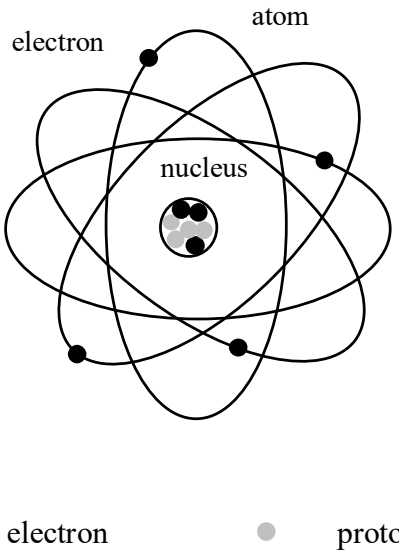


Figure 1: The Figure of the Atom After the Discovery of the Proton

This model of the structure of the atom with the solid nucleus of protons and electrons and other electrons orbiting the nucleus lasted only about 20 years, until 1932, when James Chadwick discovered that the nucleus of the atom is not made of protons and electrons, but that it consists of two particles, one of which was indeed the proton particle which as we described above had already been discovered, but the other particle was not the electron but was a neutral, new particle without charge, with mass about equal to the mass of the proton which, because it was a neutral particle, was given the name "neutron". Thus, the new image of the atom at that time was formed as shown in Figure 2 below, that is: from a nucleus, which consisted of a set of protons and neutrons, (which constituted the solid part of the atom), around which revolve the electrons.

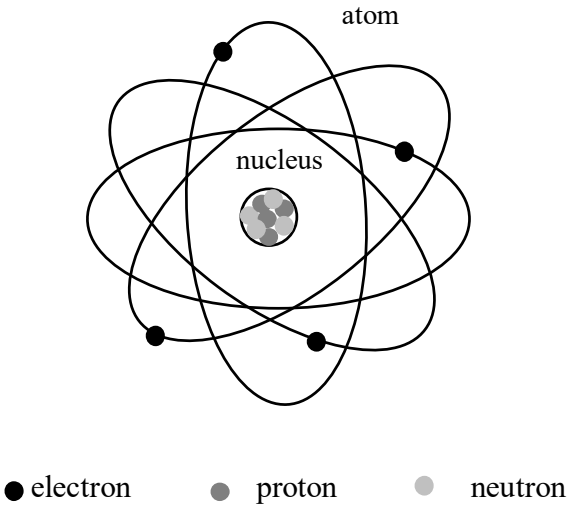


Figure 2: The Figure of the Atom After the Discovery of the Neutron

With the discovery of the electron, proton, and neutron, which were also thought to be the elementary particles of matter and after the completion of the above model of the structure of atoms, scientists thought that research into the structure and origin of matter had finish. In fact, some scientists hastened to declare that in a very short time the research of the structure of the microcosm will be completed. But once again the scientists were refuted since in the 1970s the theoretical physicist Murray Gell-Mann theoretically proved that protons and neutrons are composed of triads of other particles that scientists called quarks. In the same decade, quarks were also discovered experimentally at the California Institute of Technology, where when high-speed protons collided with other protons, it was shown that protons and neutrons were not elementary particles. In particular, it was shown that protons and neutrons are complex particles and that they consist of triads of other particles, the up quarks and the down quarks. With the discovery of the up and down quarks which together with electrons were thought to be elementary particles began the formation of the Standard Model theory, of elementary particles, as an offshoot of the Quantum theory.

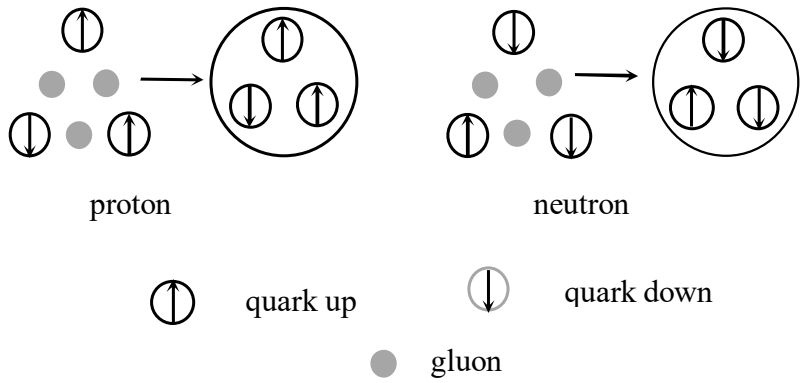


Figure 3: The Formation of Proton and Neutron from Quarks

In a few words, the Standard Model theory describes the elementary particles of matter and antimatter and the fundamental interactions from which the rest of the particles, matter, and material bodies were created. The elementary particles as described by the theory are divided into two large categories, namely: a) the elementary particles from which matter is created, the fermions, and b) the particles of the interactions, the bosons.

Fermions as the fundamental building blocks of matter and antimatter are grouped into two families which are:

The six quarks: Up quark (u) with charge 2/3e, and down quark (d) with charge -1/3e, charm quark (c) with charge 2/3e, and strange quark (s) with charge -1/3e, and top quark (t) with charge 2/3e, and bottom quark (b) with charge -1/3e.

And the six leptons: The electron (e) with charge -1e and the electron neutrino (ne), with charge 0e, the muon (μ) with charge -1e, and the muon neutrino (nm), with charge 0e, and the tau (t) with charge -1e, and the neutrino of tau (nt), with charge 0e.

Bosons are the carriers of interactions and are:
The photon (γ), carrier of the electromagnetic interaction, the particles, W+, W-, and Z- carriers of the weak interaction, the gluon (g) carrier of the strong interaction, and the Higgs particle that does not take part in interactions but creates the mass of elementary particles. The possibility of describing gravity through a boson is also being investigated, for which, although there is no evidence so far, it has already been named graviton. The corresponding theory that is being developed for the gravitons has already been called the Quantum Theory of Gravity.

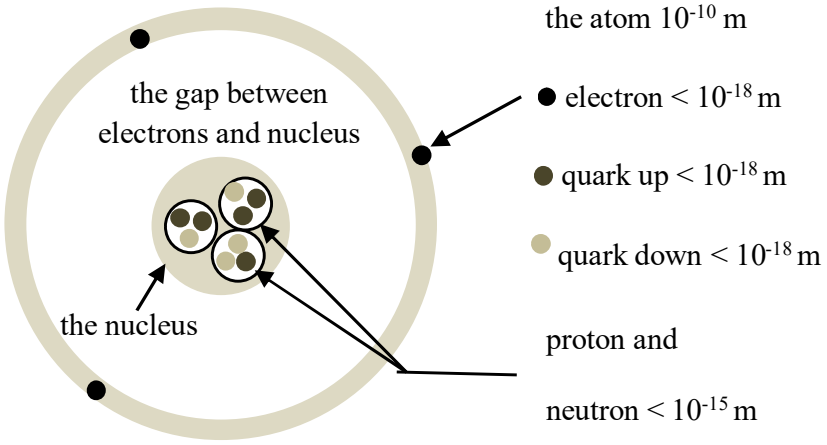


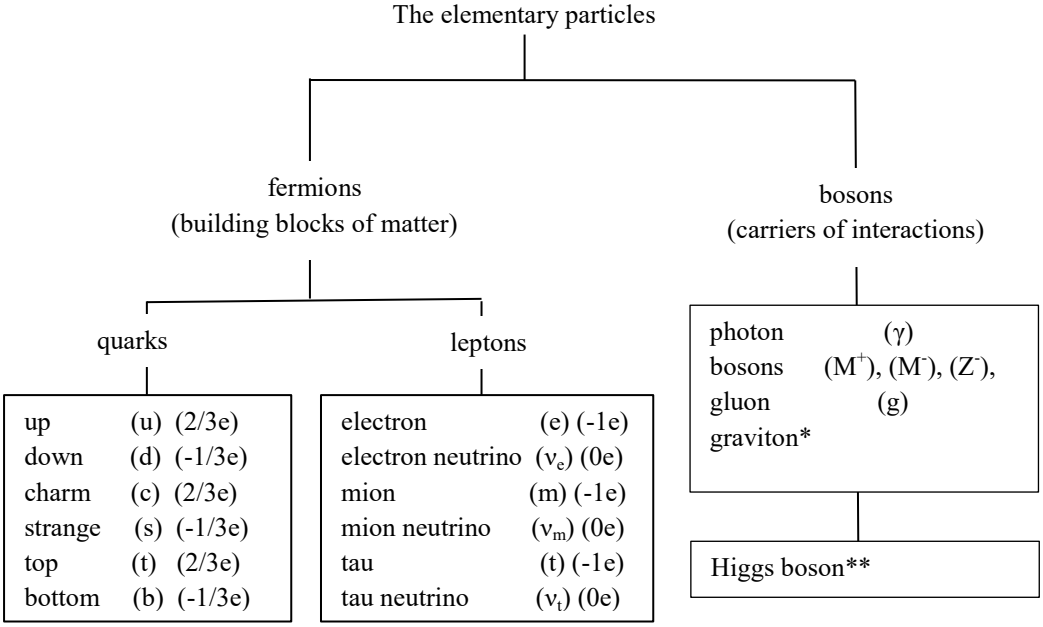
Figure 4: The Form of the Atom as of Today

From the fermions I described above, I will distinguish the electron and the up and down quarks which are the particles that contribute to the creation of matter and antimatter, as physics accepts today. The up and down quarks have the same rest mass of 310MeV/c2 and a charge of the up quark +2/3e, and the dawn quark -1/3e of the charge of the proton. The combinations of up and down quarks that made protons and neutrons are: Two up quarks and a down quark made a proton and two down quarks and an up quark made a neutron, as shown in Figure 3 on page 4. The picture of the structure of the atom after the discovery of quarks took the form that is valid until today as shown in Figure 4. In Figure 4, the dimensions of subatomic and subnuclear particles as they have been determined, from experiments and theoretical calculations, are also marked. These dimensions lead us to a better understanding of the size and structure of the atoms. Below, I give the table of the elementary particles according to the theory of the Standard Model. To each fermion correspond an antiparticle, bosons do not have antiparticles.

3.4.2. Generation Model Competition

Upon completing the training process, we've devised a method to evaluate the finetuned GPT-2 model's performance, ensuring its accuracy in generating output based on the provided header data. To assess the similarity between the generated and original text, we input the model with the same header data used during training. Then, leveraging the SimCSE model, we vectorize the text content for comparison, assessing their similarity by calculating the Euclidean distance between the vectors [21]. The SimCSE model offers advantages in both supervised and unsupervised data settings, enabling us to achieve more favorable outcomes in sentence similarity evaluations.

After adjusting various parameters and experiment sizes, we employ the degree of similarity to determine the most successful GPT-2 model in generating the most concise text, which then serves as the final model.



Note: *The graviton particle has not yet been detected; there is not any characteristic of it, except that it must be a very weak boson. That is why it is not included in the Standard Model theory.
**The Higgs boson does not take part in interactions but contributes to the creation of the masses of the elementary particles.

Table 1: The Elementary Particles, According to the Standard Model Theory

3. The Properties of Elementary Particles, the Yang-Mills Theory and the "Mass Gap" of the Theory

The laws of Quantum physics, into the world of subatomic and elementary particles, i.e. into the microcosm, work in the same way as the laws of classical Newtonian mechanics work in the macrocosm. This remarkable framework was introduced by Yang and Mills in the 1970s to describe elementary particles, using structures of the Euclidean geometry. Thus Yang-Mills theory became the foundation of the theory for investigating the properties of elementary particles and interactions and its predictions have been verified in many experiments. But the success of the theory rested on a subtle quantum mechanical property called the "mass gap". This property has been confirmed in many experiments, but it is a property whose mathematical basis is still unclear.

However, to establish the Yang-Mills theory, the property of the "mass gap" must be clarified, something that worries theoretical physicists and mathematicians. It is believed that progress in establishing the Yang-Mills theory and the existence of the "mass gap" will require the introduction of new fundamental ideas in both physics and mathematics. Today the Yang-Mills "mass gap" problem is considered as an unsolved problem in physics and mathematics and was included in the seven Millennium Prize problems set by the Clay Mathematics Institute, which has offered a one-million-dollar prize for its solution.

In May 2000, the prestigious Clay Institute of Mathematics proclaimed seven cash prizes, worth one million dollars each, for the solution of an equal number of mathematical problems, which a group of internationally renowned mathematicians had described as the most difficult and important unsolved problems of our time. These problems became known as the Millennium Problems. Among these problems is the Yang-Mills "mass gap" problem.

4. The Remaining Weak Points of the Standard Model theory

But apart from the Yang-Mills "mass gap" presented by the Standard Model theory, there are many other weak points of the theory that must be clarified before its final establishment. But since the subject of this work is not the weaknesses of the Standard

Model theory, I will only mention some of these weaknesses without describing them in detail, giving only indications in which references the reader can find their details to study them. Thus, the theory of the Standard Model must be explained before its final establishment:

- How is energy transformed into matter [6]? Specifically, how did energy create quarks and the electron [6]?
- Are quarks and electrons elementary particles [1]?
- If and how do quarks move, inside the nucleus of the atom [1]?
- Who is and how did the mechanism work, which created the unified interaction that gave rise to the four fundamental interactions [6] and [2]?
- Do bosons exist [2]? And if there are
- How were they created [2]? And how do they integrate and cooperate with matter [2]?
- What are the details of the operation of the Higgs mechanism [7] and [6]?
- How were the nuclei of atoms [1] been created?
- Are neutrinos elementary particles? As provided by the Standard Model [6]?
- How does the Standard Model theory explain the accelerated motion of galaxies [1], [6]?
- How was so much more matter than antimatter created in the Universe [5]?
- Does matter attract or repel antimatter [2]?
- What are the causes that created gravity [2]?
- What is and where are the graviton particles [6]? Etc.

5. The New Model for the Subatomic and Elementary Particles

In section 2 we saw that with the discovery of the quark up and quark down which together with the electron were considered elementary particles, the theory of the Standard Model was established as an offshoot of the theory of Quantum. In the previous section, I described some weak points of the theory, which need to be clarified before establishing the theory. However, in addition to the weak points I have described, there is also another weak point, which is that: there are many other worthy proposals for the renewal or replacement of the theory of the Standard Model, which, however, for unknown reasons are rejected, without being studied or are taken into account.

Among these proposals is the New Model that I describe next for the origin of the structural components of matter and the strong, weak, and electromagnetic interactions between them. The New Model describes with greater clarity, simplicity and reliability the origin of the structural components of matter and the interactions between them including the interaction of gravity, and clarifies the case of the "mass gap". Also, the New Model that I propose is fully adapted to all the theoretical and experimental data of science to date.

So according to the New Model:

"Everything in the Cosmos[2] was created from two particles, the Pointon, and the Antipointon, and from a single interaction, the Electromagnetic Interaction!"

The ***electromagnetic interaction*** is created along with the creation of the pointons and antipointons particles, like an attraction or repulsion, between these particles without the need for the mediation of a boson to create this attraction or repulsion. With the creation of the pointons and antipointons a rapid chain reaction of production of pointons and antipointons began, which continues to produce particles to this day at the limits of the Cosmos. The particles produced by the chain reaction are elementary particles, the smallest subdivisions of matter and antimatter. They are simple +1/3e (pointon) and -1/3e (antipointon) charges, massless[3], with inertial, and have almost zero dimensions ($<10^{-30}$m) [1].

With the help of the electromagnetic interaction, the particles and the antiparticles are attracted or repulsed to each other and: a) or collide and destroy each other, b) or enter rotational orbits around their opposite particles [1]. In the second case, they create the next generation of particles, which are particles with mass and dimensions, namely: the up and down quarks, the electron, and their antiparticles, as shown in Figure 5 below. Figure 5 also shows the structure of up and down quarks and the electron, which indicates that up and down quarks and the electron are not elementary, but are composite particles.

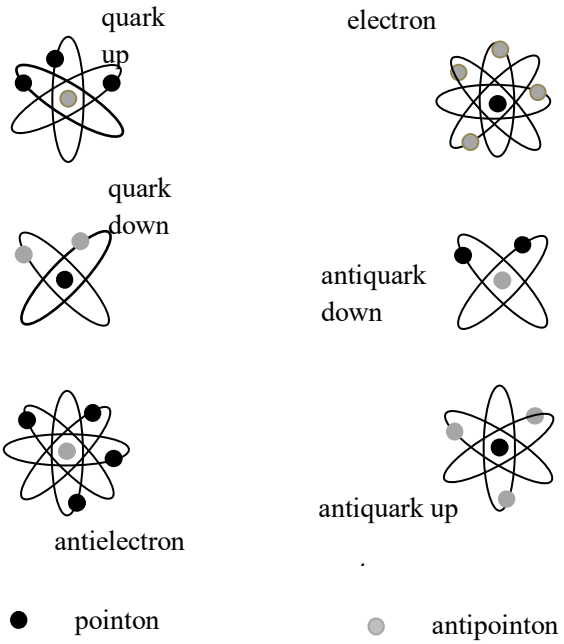


Figure 5: The Combinations of Pointons and Antipointons That Formed the Basic Particles of Matter And Antimatter

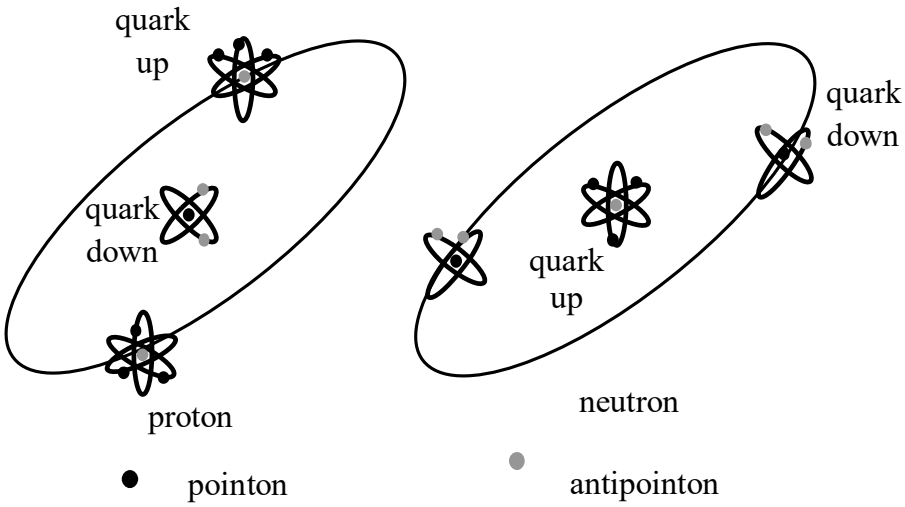


Figure 6: The Suggested Indicative Structures of Proton and Neutron

Then, without needing any other interaction, protons and neutrons are created from the up and down quarks and again with the help of spin orbits as shown in Figure 6. Together with the protons and neutrons the first primary gradation is created by the electromagnetic interaction the strong nuclear interaction, which contributed and contributes to the creation of the nuclei of Helium. Hydrogen nuclei had already been created, since they consist of simple protons.

From the nuclei of Hydrogen, Helium, and the electrons, the atoms of Hydrogen and Helium were created, in the known ways that we all know, without needing any other interaction. But together with the creation of the atoms of Hydrogen, and Helium, the second primary gradation of the electromagnetic interaction was created, the ***interaction of gravity***, which contributed and contributes to the creation of molecules, matter and antimatter, and then directs all creation and operation of our Universe and the Cosmos.

[2]According to the Chain Reaction theory, along with the Universe, the Antiuniverse is also created. Created, many other Universes and Antiuniverses too, which all together create Cosmos, [1].

[3]In the New Model there is no "mass gap" since the elementary particles pointons and antipointons have no mass and the mass of the remaining particles is created as a difference dFe of the electromagnetic forces of the elementary particles when they enter in rotational orbits around the opposites charged particles, to form the next generations of particles [2].

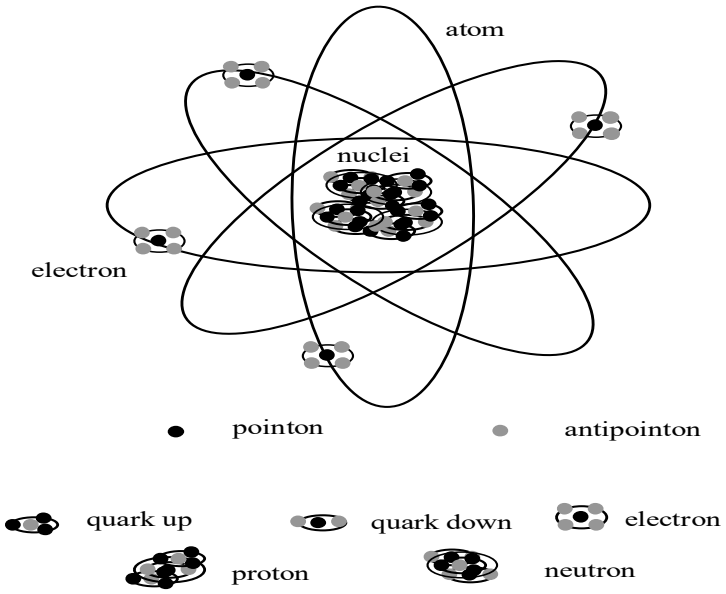


Figure 7: The Structure of the Atom According to the New Model

All these, as I will describe in my book "The First Second" happened within the first second from the beginning of the creation. The remaining interactions namely: ***Weak nuclear force***, radioactivity, heat, light, magnetism, etc. are created during the accelerations of subatomic and subnuclear particles and are characterized by the New Model as secondary gradations of the electromagnetic interaction.

electromagnetic interaction
created along with the creation
of the pointons and antipointons*
contribute to the creation
of quarks, electrons, protons, neutrons,
atoms their antiparticles
and all the other interactions

primary gradations
of the electromagnetic interaction

strong nuclear interaction
created along with the creation
of protons and neutrons.
contribute to the creation of nuclei

gravitational interaction
created, along with the creation of the atoms.
contribute to the creation of molecules,
matter and antimatter, directs the functioning
of all the Cosmos.

secondary gradations
of the electromagnetic interaction

weak nuclear interaction, radioactivity,
heat, light, magnetism, etc.
created during the inductions
of subatomic and sub nucleus particles

Table 2: The Classification of the Fundamental Interactions According to the Theory of the Chain Reaction

Note: *According to the New Model, the elementary components of matter and antimatter, as well as all interactions are limited to the two particles the ***pointon*** and the ***antipointon*** and the ***electromagnetic interaction***.!

[4]As subatomic particles are characterized all the particles are inside the atom, as elementary particles are characterized the smallest subdivisions of matter and antimatter.

[5]I personally believe and have absolute certainty that by studying the New Model all the weak points of the theory of the Standard Model would be clarified and new horizons would be opened in the evolution of Physics.

Table 2 summarizes the whole process above. But I have a feeling that I've tired you enough with my pointons and antipointons, the chain reaction, and the gradations of the electromagnetic interaction. This is why I am closing the work, leaving the rest of the details for readers, who want to delve deeper and study the subject of particles and interactions, to find and study them in my books, and in references [1-7].

6. Judgments, Conclusions and Proposals

If we recapitulate the properties and the function of the subatomic and elementary particles[4] that we described in the previous sections we will notice that with the discovery of the divisibility of the atom began the formation of the Quantum theory, a theory that examines the properties and the behavior of particles that they are inside the atom. The theory was progressing very smoothly until the discovery of the up and down quarks.

With the discovery of the up and down quarks, which together with the electron were considered the elementary particles, i.e. the smallest subdivisions of matter and antimatter, the theory of the Standard Model began to be established, as an offshoot of the theory of Quantum for the study and the investigation of elementary particles. But the theory of the Standard Model, as I describe in sections 3 and 4 above, rested on faulty foundations and does not agree with much of the existing experimental and theoretical data of science. This is why science must: either revise its existing data, which is probably impossible to happen: or readjust the Standard Model according to the existing data.

Unfortunately, however, the supporters of the Standard Model theory, who also represent the established views of science, oppose the revision of the theory, or make wrong choices in their attempt to readjust the data of the theory, as for example: the de facto establishment of quarks and of the electron as elementary particles, while there are clear indications that these are not elementary particles and: the explanation of the phenomenon of the accelerated movement of the galaxies through the disputed concepts of "dark energy" and "dark matter", etc., with resulting in the situation becoming even more confused.

At the same time, they reject, for unknown reasons, all the new opinions that come from small researchers, such as for example the New Model that I propose above, a proposal that I believe could offer very positive results in science[5]. In this sense, I consider it necessary that established science, in its research, in addition to the Big Universities and the Big Research Centers, should also include the small researchers that today it has ignored, thus excluding from its research, the greater part of scientists. Of course, the works of small researchers are very many and in the majority of them they are wrong works, but it is quite easy for science, as long as there is good will, to single out the correct works and study them. Let's not forget that when Copernicus and Galileo proposed the theory of the Heliocentric System, on which the new current Cosmology was based, they were then characterized as insignificant and rather as heretical researchers.

And I will finish the paper with two questions: *is the scientific world aware of this existing situation?* And, if he is aware, *how does he react?* At the same time, allow me to make a personal proposal to the readers who will read the paper, to study it very carefully and if they find it interesting, to support it. Don't let the work go unnoticed. Science needs such works. Supporting the work is the greatest service you could offer to Physics and Cosmology today. I believe that by studying and supporting the work, and establishing the theory of the New Model, all issues: Of subatomic particles, the divisibility or not of the up and down quarks and the electron, the existence or not of the bosons, the fundamental interactions, the accelerated expansion of the Universe, the dark energy and dark matter etc., will be resolved.

By the establishment of the New Model, the problem of the "mass gap" will be automatically solved too, since all calculations of the Young-Mills theory will have to be re-examined, according to the views of the New Model. But in the New Model, the elementary particles pointons and antipointons have no mass, and the mass of the remaining subatomic particles is created when the elementary particles pointons and antipointons enter in spin orbits around their oppositely charged particles, to create the next generations of particles. In this case, a tiny small remainder of the sum of the electromagnetic forces, dF_e [2], between the pointons and antipointons, which creates the masses of the other subatomic particles, is created.

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